

## Guiding principles for rewilding

Carver, Steve; Convery, Ian; Hawkins, Sally; Beyers, Rene; Eagle, Adam; Kun, Zoltan; Van Maanen, Erwin; Cao, Yue; Fisher, Mark; Edwards, Stephen R.; Nelson, Cara; Gann, George D.; Shurter, Steve; Aguilar, Karina; Andrade, Angela ; Ripple, William J.; Davis, John; Sinclair, Anthony; Berkoff, Marc; Noss, Reed; Foreman, Dave; Pettersson, Hanna; Root-Bernstein, Meredith; Svenning, Jens-Christian; Taylor, Peter ; Wynne-Jones, Sophie; Featherstone, Alan Watson; Flojgaard, Camilla; Stanley-Price, Mark; Navarro, Laetitia M.; Aykroyd, Toby; Parfitt, Alison; Soule, Michael

## Conservation Biology

DOI:

<https://doi.org/10.1111/cobi.13730>

Published: 01/12/2021

Publisher's PDF, also known as Version of record

[Cyswllt i'r cyhoeddiad / Link to publication](#)

*Dyfyniad o'r fersiwn a gyhoeddwyd / Citation for published version (APA):*

Carver, S., Convery, I., Hawkins, S., Beyers, R., Eagle, A., Kun, Z., Van Maanen, E., Cao, Y., Fisher, M., Edwards, S. R., Nelson, C., Gann, G. D., Shurter, S., Aguilar, K., Andrade, A., Ripple, W. J., Davis, J., Sinclair, A., Berkoff, M., ... Soule, M. (2021). Guiding principles for rewilding. *Conservation Biology*, 35(6), 1882-1893. <https://doi.org/10.1111/cobi.13730>

### Hawliau Cyffredinol / General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.







- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

### Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## CONTRIBUTED PAPER

# Guiding principles for rewilding

Steve Carver<sup>1</sup>  | Ian Convery<sup>2</sup>  | Sally Hawkins<sup>3</sup> | Rene Beyers<sup>4</sup> | Adam Eagle<sup>5</sup> | Zoltan Kun<sup>6</sup> | Erwin Van Maanen<sup>7</sup> | Yue Cao<sup>8</sup>  | Mark Fisher<sup>9</sup> | Stephen R. Edwards<sup>10</sup> | Cara Nelson<sup>11</sup> | George D. Gann<sup>12,13</sup> | Steve Shurter<sup>14</sup> | Karina Aguilar<sup>15</sup> | Angela Andrade<sup>10,16</sup> | William J. Ripple<sup>17</sup> | John Davis<sup>18</sup> | Anthony Sinclair<sup>4</sup> | Marc Bekoff<sup>19</sup> | Reed Noss<sup>20</sup>  | Dave Foreman<sup>18</sup> | Hanna Pettersson<sup>21</sup> | Meredith Root-Bernstein<sup>22,23,24</sup>  | Jens-Christian Svenning<sup>25,26</sup> | Peter Taylor<sup>9</sup> | Sophie Wynne-Jones<sup>27</sup> | Alan Watson Featherstone<sup>28</sup> | Camilla Fløjgaard<sup>29</sup> | Mark Stanley-Price<sup>30</sup> | Lactitia M. Navarro<sup>31,32</sup>  | Toby Aykroyd<sup>33</sup> | Alison Parfitt<sup>9,†</sup> | Michael Soule<sup>34,†</sup>

<sup>1</sup> School of Geography, University of Leeds, Leeds, UK<sup>2</sup> National School of Forestry, University of Cumbria, UK<sup>3</sup> Institute of Science, Natural Resources and Outdoor Studies, University of Cumbria, UK<sup>4</sup> Biodiversity Research Centre, Department of Zoology, University of British Columbia, Vancouver, British Columbia, Canada<sup>5</sup> The Lifescape Project, London, UK<sup>6</sup> Wild Europe, Győr, Hungary<sup>7</sup> Rewilding Foundation, Diepenveen, The Netherlands<sup>8</sup> Institute for National Parks, Tsinghua University, Beijing, China<sup>9</sup> Wildland Research Institute, University of Leeds, Leeds, UK<sup>10</sup> Commission for Ecosystem Management, IUCN, Gland, Switzerland<sup>11</sup> W.A. Franke College of Forestry & Conservation, University of Montana, Missoula, USA<sup>12</sup> The Institute for Regional Conservation, Delray Beach, Florida, USA<sup>13</sup> Society for Ecological Restoration, Washington, D.C., USA<sup>14</sup> White Oak Conservation, Jacksonville, Florida, USA<sup>15</sup> Agencia Metropolitana de Bosques Urbanos del AMG, Guadalajara, Mexico<sup>16</sup> Conservation International Colombia, Bogota, Colombia<sup>17</sup> Department of Forest Ecosystems and Society, Oregon State University, Corvallis, Oregon, USA<sup>18</sup> The Rewilding Institute, Albuquerque, New Mexico, USA<sup>19</sup> Ecology and Evolutionary Biology, University of Colorado, Boulder, Colorado, USA<sup>20</sup> Florida Institute for Conservation Science, Melrose, Florida, USA<sup>21</sup> Sustainability Research Institute, School of Earth and Environment, University of Leeds, Leeds, UK<sup>22</sup> UMR CESCO, CNRS, Musée National d'Histoire Naturelle, Paris, France<sup>23</sup> Center for Applied Ecology and Sustainability, Santiago, Chile<sup>24</sup> Instituto de Ecología y Biodiversidad, Universidad de Chile, Santiago, Chile<sup>25</sup> Center for Biodiversity Dynamics in a Changing World (BIOCHANGE), Aarhus University, Aarhus, Denmark

-----  
This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2021 The Authors. *Conservation Biology* published by Wiley Periodicals LLC on behalf of Society for Conservation Biology



<sup>26</sup> Section for Ecoinformatics and Biodiversity, Department of Biology, Aarhus University, Aarhus, Denmark

<sup>27</sup> School of Natural Sciences, Bangor University, Bangor, UK

<sup>28</sup> Freelance Ecologist, Findhorn, UK

<sup>29</sup> Department of Bioscience, Aarhus University, Aarhus, Denmark

<sup>30</sup> WildCRU, University of Oxford, Oxford, UK

<sup>31</sup> German Centre for Integrative Biodiversity Research (iDiv), Leipzig, Germany

<sup>32</sup> Martin Luther University Halle-Wittenberg, Halle, Germany

<sup>33</sup> Wild Europe, Brussels, Belgium

<sup>34</sup> Society for Conservation Biology, Washington, D.C., USA

#### Correspondence

Steve Carver, School of Geography, University of Leeds, Leeds LS2 9JT, UK.

Email: [s.j.carver@leeds.ac.uk](mailto:s.j.carver@leeds.ac.uk)

<sup>†</sup>Deceased.

#### Abstract

There has been much recent interest in the concept of rewilding as a tool for nature conservation, but also confusion over the idea, which has limited its utility. We developed a unifying definition and 10 guiding principles for rewilding through a survey of 59 rewilding experts, a summary of key organizations' rewilding visions, and workshops involving over 100 participants from around the world. The guiding principles convey that rewilding exists on a continuum of scale, connectivity, and level of human influence and aims to restore ecosystem structure and functions to achieve a self-sustaining autonomous nature. These principles clarify the concept of rewilding and improve its effectiveness as a tool to achieve global conservation targets, including those of the UN Decade on Ecosystem Restoration and post-2020 Global Biodiversity Framework. Finally, we suggest differences in rewilding perspectives lie largely in the extent to which it is seen as achievable and in specific interventions. An understanding of the context of rewilding projects is the key to success, and careful site-specific interpretations will help achieve the aims of rewilding.

#### KEYWORDS

definition, ecosystem management, goals, guiding principles, rewilding

#### Resumen

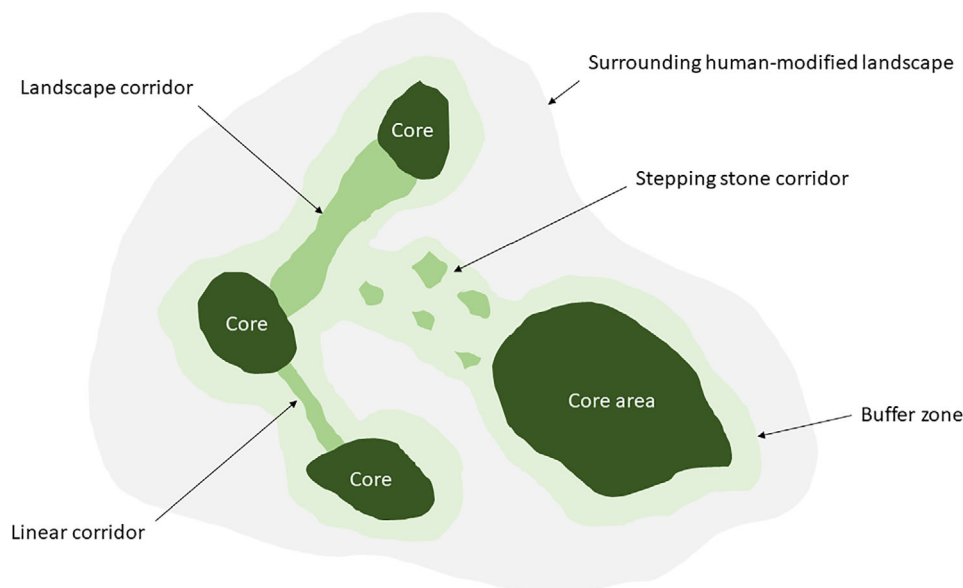
Recientemente ha habido mucho interés por el concepto de retorno a la vida silvestre como herramienta para la conservación de la naturaleza, pero también ha habido confusión por la idea que ha limitado su utilidad. Desarrollamos una definición unificadora y diez principios básicos para el retorno a la vida silvestre por medio de encuestas a 59 expertos en retorno a la vida silvestre, un resumen de las visiones de las organizaciones más importantes para el retorno a la vida silvestre y talleres que involucraron a más de 100 participantes de todo el mundo. Los principios básicos transmiten que el retorno a la vida silvestre existe en un continuo de escala, conectividad y nivel de influencia humana y que su objetivo es restaurar la estructura y las funciones del ecosistema para lograr una naturaleza autónoma autosustentable. Estos principios aclaran el concepto del retorno a la vida silvestre e incrementan su efectividad como herramienta para lograr los objetivos mundiales de conservación, incluyendo aquellos de la Década de la ONU para la Restauración de Ecosistemas y el Marco de Trabajo de la Biodiversidad Global post 2020. Finalmente, sugerimos que las diferencias en las perspectivas del retorno a la vida silvestre yacen principalmente en el grado al que es visto como factible y en intervenciones específicas. Un entendimiento del contexto de los proyectos de retorno a la vida silvestre es importante para el éxito, y las interpretaciones específicas de sitio ayudarán a lograr las metas del retorno a la vida silvestre.

Principios Básicos para el Retorno a la Vida Silvestre

## INTRODUCTION

The concept of rewilding emerged in North America in the 1980s, where it was originally called “wilderness recovery”

(Noss, 1985), and has become increasingly popular worldwide (Johns, 2019). Originally, rewilding concerned safeguarding and restoring native biodiversity through large-scale, interconnected networks of reserves established primarily to protect



**FIGURE 1** The Cores, Corridors, and Carnivores (3Cs) model of rewilding (adapted from Soulé & Noss, 1998)

interacting keystone species and their trophic relationships (Power et al., 1996). Soulé and Noss (1998) published a landmark paper describing the scientific basis for rewilding. They describe three key features: large core protected areas, ecological connectivity, and keystone species. This is the “3Cs” model of cores, corridors, and carnivores (Figure 1) that was refined with the addition of climate resilience (Carroll & Noss, 2020), compassion (Bekoff, 2014; Kopnina et al., 2019), and coexistence (Johns, 2019).

Rewilding projects have been initiated around the world as a response to biodiversity loss and the climate crisis and are relevant to the UN Sustainable Development Goals and Decade on Ecosystem Restoration, Global Biodiversity Framework, Nature-based Solutions (NbS), and human health initiatives. Rewilding has evolved to encapsulate a range of themes, including the relationships between humans and nature, deep ecology, ecotourism, and bushcraft.

The driving force behind rewilding is that even where there are large-scale areas protecting whole ecosystems, biological communities continue to unravel and species are still being lost. The sixth mass extinction underway is being driven largely by human population growth, overconsumption and resource exploitation, habitat loss, and climate change (Ceballos et al., 2015; Payne et al., 2016; Ripple et al., 2017). Although many traditional modes of conservation are rearguard actions (Johnson et al., 2017), rewilding is an optimistic approach that demonstrates reversal of the loss of natural ecosystems and their key components and benefits to human well-being (Noss, 2020).

Rewilding now incorporates a variety of concepts, including Pleistocene megafauna replacement, taxon replacement, species reintroductions, retrobreeding, release of captive-bred animals, land abandonment, and spontaneous rewilding. Jørgensen (2015) describes rewilding as “a plastic term,” indicating how it evolved and was modified to fit the aims of individual projects.

This lack of consistent use is widely recognized as responsible for the misrepresentation of rewilding in practice and policy (Pettorelli et al., 2018). Although some researchers support rewilding’s multivalence as encouraging diversity, creativity, and debate, echoing the wild in its sense of uncertainty and adaptability (Deary & Warren, 2017; Gammon, 2018), others assert that this distracts from its ecological aims and has a diluting effect. They argue that this complexity is a hinderance to rewilding’s application (Hodder & Bullock, 2020). Although rewilding’s definition and principles should be globally relevant, many aspects may be culturally specific, such as concepts of wilderness (Foreman, 2014; Ward, 2019); however, frameworks to address these concerns have been developed (Perino et al., 2019).

Attempts to provide a global definition of *rewilding* have not fully captured rewilding’s complex, transdisciplinary nature and potential, leading to concerns about how it relates to disciplines such as ecological restoration. Hayward et al. (2019) criticize *rewilding* as too fuzzy a term and argue that *rewilding* is better framed within the established field of ecological restoration. Their article elicited several responses pointing out that although rewilding may be a subdiscipline of restoration, all restoration is not rewilding (Anderson et al., 2019; Derham, 2019).

From the beginning, *rewilding* has referred to the science-based restoration of self-regulating ecosystems and to a transformation in human–nature relationships (Soulé, 1999). Much of the complexity of the term comes from its transdisciplinary nature, biological and spatial reach, and the potential to create or inspire ecological and cultural change. If rewilding is to help address pressing conservation issues, then a clear and broadly agreed upon definition and guiding principles are required.

The International Union for Conservation of Nature Commission on Ecosystem Management (CEM) mandated a



Rewilding Task Force (RTF), now the Rewilding Thematic Group (RTG), to work toward an internationally recognized definition and establish a set of universal guiding principles for rewilding. We reviewed research to determine global perspectives on rewilding; developed a unified definition and goals of rewilding based on that research; and developed guiding principles. Because the definition and guiding principles require broad support to provide a basis for the advancement of applied rewilding as adapted to the differing ecological and socioeconomic systems around the world, our overarching objective was to provide unifying focus for the field of rewilding to enable identification of gaps in knowledge and tailoring of research so that concepts can be further refined and contribute to robust rewilding guidelines. Using a combination of research and consultation activities, we established, together with a global community of rewilding experts, a unified set of guiding principles for rewilding. These have been adopted by the Natural Capital Laboratory in the United Kingdom and were used to help develop principles in the Global Charter for Rewilding Earth (Wilderness Foundation, 2020).

## METHODS

The RTF established the definition and list of rewilding principles presented here. They relied on careful triangulation between the literature, pioneer surveys, and consultations, followed by a series of consensus-based workshops.

### Literature review

A literature review was undertaken to establish the drivers behind the evolution of rewilding and inform questions for the rewilding pioneers survey. We were particularly interested in understanding the principles incorporated in the concept, its aims, and the methods used to achieve these. A Web of Knowledge (WoK) search was undertaken for the term “\*wilding” in article titles, abstracts, and keywords in articles published from 1990 to June 2018; 435 articles were returned. The search term was intentionally broad. Articles that did not relate to ecology, conservation, nature (or related social aspects), or nonhuman species were removed, resulting in a final list of 205. Subsequently, other relevant articles and more recently published articles from publications not indexed in WoK, such as ECOS and Wild Earth, were added.

### Rewilding pioneers survey

A questionnaire with 25 questions relating to historical and current rewilding concepts and practice (Appendix S1) was sent to selected rewilding pioneers, who first shaped the concept, and were identified through publications in the literature review and published books and by self-identification and personal recommendations. Invitations to participate were sent to 126 people. Fifty-nine responses were received: 26, United States;

10, United Kingdom, seven, The Netherlands; six, Australia; two, Spain; and one each, Argentina, Cambodia, Canada, Denmark, France, Germany, Greece, Mauritius, Mexico, Switzerland, and Tanzania. Information was categorized into themes based on geographic location, rewilding context and history, barriers to rewilding, rewilding aims, and rewilding methods and application.

The 10 rewilding principles presented were derived through merging and filtering of written principles identified in the pioneer survey and expert and practitioner workshops. Using the results from the initial survey, we identified 10 organizations and individuals as representative of geographical range and asked them to provide their own lists of rewilding principles. These were combined into a single list. Similar principles were merged into a single simplified statement. This process resulted in 50 “principles” of rewilding (Appendix S2).

## Workshops

A series of five workshops were used to solicit expert opinion. Workshops were attended by over 100 experts from geographically diverse locations. At the initial meeting, participants merged and filtered the 50 principles down to 10. Subsequent workshops were used to present, consider, and fine tune the 10 principles and accompanying definitions.

## RESULTS

### Literature review

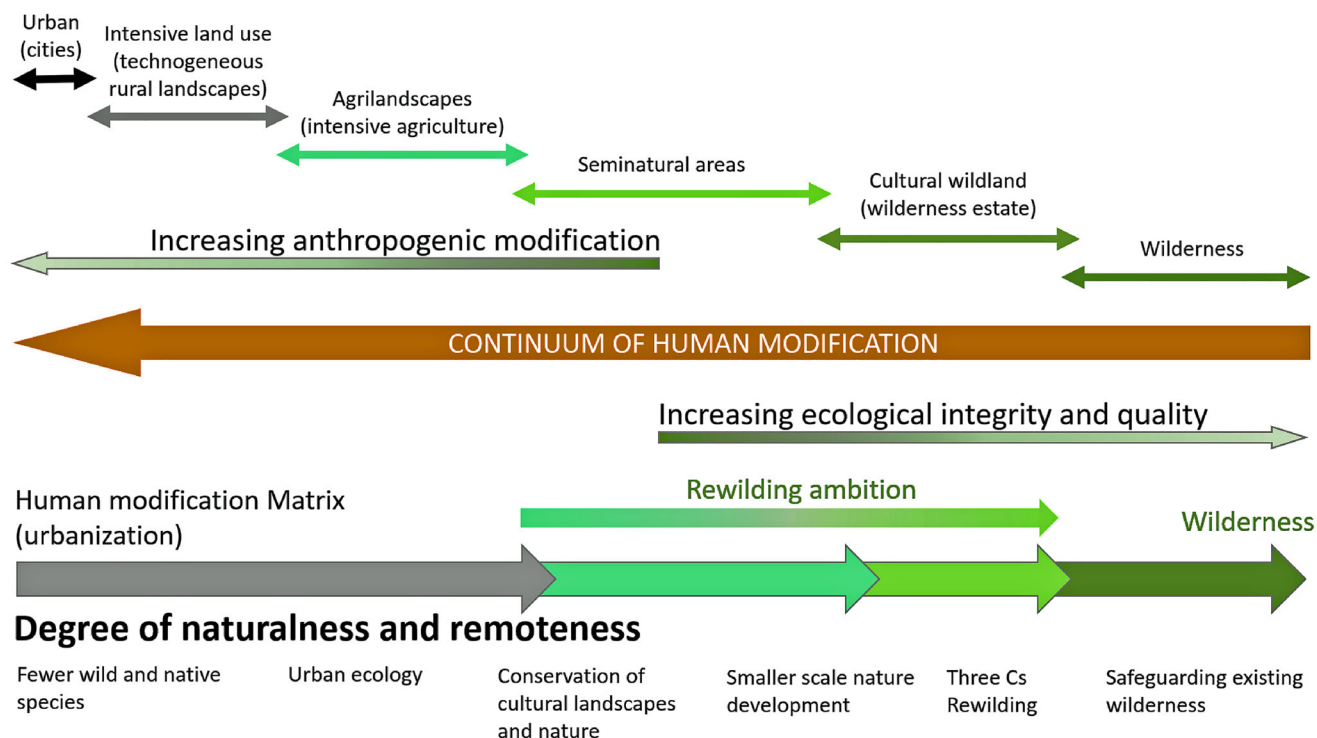
The most notable factors cited in reviewed articles as contributing to the evolution of the rewilding concept were development of the Anthropocene theory and increased urgency due to the extinction crisis (Brown et al., 2011); emergence of key ecological concepts and discoveries, such as extinction dynamics, island biogeography, metapopulation theory, natural disturbance ecology, role of highly interactive species at effective population densities, especially large carnivore and herbivore ecology (Guyton et al., 2020; Paine, 1980; Repanshek, 2019), and associated trophic cascades (Ripple et al., 2014); landscape-scale ecological restoration (e.g., Foreman, 1998; Soulé & Noss, 1998); increased pressures from urbanization and opportunities created by land abandonment (Navarro & Pereira, 2015); negative impacts of pessimistic conservation communication; increasingly positivistic approach to conservation science and policy (Bocking, 2015; Murray, 2017); and, to a more limited extent, the monetization of nature via the natural capital approach (Pettorelli et al., 2018).

The principles of rewilding have been expanding within this context. The most notable of these are summarized in Table 1. Although there is debate regarding some of these principles, the 10 presented are the most widely cited. For example, rewilding is sometimes perceived as trying to create analogues of pre-determined past conditions. Some espouse this approach (e.g., Donlan et al., 2006; Vera, 2000), but such targets may be

**TABLE 1** Summary of key values and characteristics of rewilding

Rewilding key principle	Characteristic	Example key reference
Mostly an ecocentric world view, recognizing the need to reduce human dominance and control over nature or the landscape	Re-engaging society with nature, reexamining or renegotiating human relationship with ecology, encouraging a shift from anthropocentrism to ecocentrism and coexistence with other species	Brown et al., 2011; Deary & Warren, 2017; Fisher & Parfitt, 2016; Gammon, 2018; Murray, 2017; Robbins & Moore, 2013; Soulé, 1999
Based on ecological science	Emphasizing the need to incorporate ecological dynamics into managing and restoring functioning ecosystems	Brown et al., 2011; Foreman, 1998; Pringle, 2017; Soulé & Noss, 1998
Large-scale and long-term; ecological completeness in terms of trophic and community ecology, including keystone species	A focus on landscape- or continental-scales and long-term management plans beyond the time limitations of seasonal, management, or political cycles. Smaller scale efforts building on rewilding principles are also possible and valuable, e.g., in urban settings, despite inevitable limitations.	Johns, 2019; Pedersen et al., 2020; Pringle, 2017; Soulé & Noss 1998
Inspirational and active	Moving toward “bold” and “audacious” action, with much of the language used in rewilding literature bold, optimistic, and inspirational	Donlan et al., 2006; Foreman, 1998
Inclusive and collaborative	Rewilding seeks to be inclusive and collaborative across disciplines, geographies, and groups, incorporating a wide range of knowledge and expertise.	Jorgensen, 2015; Murray, 2017; Soulé & Noss, 1998
Context specific	Acknowledging that contextual and site-specific interpretations that meet the needs of a restoring wild nature are the key to successful rewilding	Bocking, 2015; Butler et al., 2019; Pires, 2017; Pringle, 2017; Root-Bernstein et al., 2018
Embraces complexity, adaptability, and autonomy	A wildness with outcomes determined by the self-assembly of wild nature. Instead of approaches that try to work within existing political and economic systems, rewilding defines the system itself as the issue and highlights the dynamism of ecological systems freed from imposed order.	Bocking 2015; Fraser et al., 2015; Pires 2017
Ethically responsible	Perceived moral need to “right the wrongs” of the Anthropocene rewilding acknowledges the rights of nonhuman nature as well as humans.	Deary & Warren, 2017; Ward, 2019
Future focused	Although rewilding takes inspiration from past conditions, it is focused on future potential rather than recreating past conditions.	Fisher & Parfitt, 2016; Wynne-Jones et al., 2019





**FIGURE 2** The wilderness continuum (after Carver [2014], Lesslie & Taylor [1985], and Van Maanen & Convery [2016])

informed by past ecological conditions and may not be replicable. These principles provide a reference point (taking shifting baselines into account) rather than rigid prescriptions for the rehabilitation of key ecological functions (Corlett, 2016; Gann et al., 2019; Kaiser-Bunbury et al., 2010; Moss, 2015; Preston, 2015; Svenning & Faurby, 2017; Tanasescu, 2017).

The most commonly cited aim of rewilding in the literature relates to the restoration of functioning ecosystems and their natural disturbance regimes (e.g., Galetti et al., 2017; Soulé & Noss, 1998), including restoring natural processes and species interactions and releasing natural processes from human control, dominance, or suppression (e.g., Pettorelli et al., 2018; Tanasescu, 2017). The converse of human control, the promotion of self-sustaining, self-willed, or self-regulated ecosystems, is also highlighted (e.g., Brown et al., 2011; Prior & Ward, 2016). However, achieving these conditions is not always possible in social–ecological systems; therefore, the emphasis is on reducing human control or dominance, sometimes depicted as a continuum of increasing ecological integrity and decreasing anthropogenic influence (Figure 2) (Carver, 2014; Lesslie & Taylor, 1985; Murray, 2017; Van Maanen & Convery, 2016). The aims of restoring biodiversity (e.g., Carey, 2016; Cloyd, 2016; Merckx & Pereira, 2015), wildness (Deary & Warren, 2017), wilderness (Carver, 2013), ecosystem services (Cerqueira et al., 2015), and human–nature relatedness (e.g., Carver, 2016; Deary & Warren, 2017; Drenthen, 2015) are also cited.

Commonalities in the concept of rewilding lie in its aims, whereas differences lie in the methods used, which include land

protection, connectivity conservation, removing human infrastructure, and species reintroduction or taxon replacement (Corlett, 2016; Hansen, 2010; Soulé & Noss, 1998; Zamboni et al., 2017). The most appropriate interventions are dictated by what is needed to facilitate a trajectory of ecosystem recovery, while recognizing the inherent, often social constraints, of a given area (Lake, 2012). Although much of the debate focuses on rewilding as an action or intervention, rewilding is also spontaneously proceeding in places where direct human influence has declined or ceased through agricultural extensification and land abandonment (Carver, 2019). This latter occurrence intersects with the concept of natural regeneration as an approach to ecological restoration (Gann et al., 2019).

### Rewilding pioneers survey

We distinguished between the different geographical interpretations and sought commonalities across regions. This summary provides key personal accounts and valuable insights from those surveyed, rather than a complete history of rewilding.

Key drivers of the emergence of rewilding included the ongoing extinction crisis and a growing dissatisfaction with traditional, single-species, “doom-and-gloom” conservation and a growing awareness of the importance of ecological function and processes. Among U.S. respondents the concept was influenced by the deep ecology and wilderness movements, whereas in Europe and elsewhere it grew partly in response to the opportunities offered by rural land abandonment. This divergence in

rewilding philosophies was reflected in the authors, organizations, and people cited in the survey. In the United States and Canada, these included The Wildlands Project (renamed The Wildlands Network) and The Rewilding Institute. Soulé and Noss (1998) provided an influential description of the scientific basis for rewilding, particularly the emphasis on continental scales, creating connectivity between core wilderness areas, and providing habitat for functioning trophic webs, including apex predators (i.e., 3Cs rewilding). In Europe, participants predominantly cited the influences of Frans Vera (2000) and the Dutch policy of Nature Development. Here, the emphasis is on more functionalist approaches to nature management compared with the classic compositional approach (Pedersen et al., 2020). Emphasis was often on the use of large herbivores to maintain disturbance through grazing, which is assumed to result in heterogeneous mixtures of open areas and woodland or wood pasture (an open landscape with scattered trees), sometimes in association with commercial ecotourism. Other rewilding initiatives focused more on excluding or reducing grazing by large herbivores (including domestic livestock and wild ungulates) to allow tree cover to regenerate (Watson Featherstone, 1997).

Another common theme was the rewilding's potential to inspire social change. Respondents acknowledged that to achieve this rewilding must tackle sociopolitical and cultural barriers, including an entrenched conservation culture, human–wildlife conflicts, economic growth, and the policies and institutions that perpetuate these. Participants noted that as these barriers have become more evident, the aims of rewilding expanded a primarily ecological focus to incorporate these sociocultural, economic, and political aspects, including complexity of social–ecological systems, the needs of humans and nature, and the desire to “rewild the human spirit as well as the land.”

Also highlighted was the need to incorporate knowledge from diverse groups, geographies, and disciplines in the application of rewilding. An element of this is the integration of rewilding with human land use to create opportunities for increasing wildness while maintaining income streams. The survey data showed that the lack of a unifying definition and understanding, of accepted approaches, and of evidence are still significant barriers to rewilding's potential. Respondents considered these shortcomings a particular issue in communities where rewilding projects have taken place because uncertainty, misinterpretation, and misinformation have caused alienation or negative feelings. Conversely, respondents thought engaging stakeholders in a genuine and tailored way or highlighting the benefits of rewilding could have a positive impact; positive public perceptions could potentially have “knock-on effects, inspiring others to rewilding the minds of others.”

## Definition and goals

The following definition is based on a synthesis of definitions from the literature review, definitions provided in the pioneer survey, and deliberations of participants attending the work-

shops. Rewilding is the process of rebuilding, following major human disturbance, a natural ecosystem by restoring natural processes and the complete or near complete food web at all trophic levels as a self-sustaining and resilient ecosystem with biota that would have been present had the disturbance not occurred. This will involve a paradigm shift in the relationship between humans and nature. The ultimate goal of rewilding is the restoration of functioning native ecosystems containing the full range of species at all trophic levels while reducing human control and pressures. Rewilded ecosystems should—where possible—be self-sustaining. That is, they require no or minimal management (i.e., *natura naturans* [nature doing what nature does]), and it is recognized that ecosystems are dynamic.

Rewilding principles should be mainstreamed into human society and should be consistent, where appropriate, with evolving principles and standards for ecological restoration (Gann et al., 2019), nature-based solutions (Cohen-Schacham et al., 2019), and the CBD Ecosystem Approach (Smith & Maltby, 2001). This is fundamentally different from many traditional modes of nature conservation that focus instead on protecting single species and habitats, often in isolation in small reserves, to meet targets and conditions identified at the point of designation (Van Meerbeek et al., 2019).

## Rewilding principles

The 10 basic principles resulted from the literature review, surveys, communications with experts and practitioners, and workshop participants. Although it is impossible to meet the expectations, interpretations, and opinions of all participants, this is a representation of the dominant points of view and discussions that were held.

In this context, we maintain that rewilding should be consistent with the following principles.

### Principle 1

Rewilding utilizes wildlife to restore trophic interactions. Successful rewilding results in, or leads to, a self-sustaining ecosystem in which native species' populations are regulated through predation, competition, and other biotic and abiotic interactions. It is crucial that consideration be given to the role large herbivores and apex predators play in maintaining and enhancing the biodiversity within landscapes. Keystone species (organisms that influence the functioning of an ecosystem disproportionate to their abundance) and ecosystem engineers (organisms that directly or indirectly modulate the availability of resources to other species by causing physical state changes in biotic or abiotic materials) are also important in securing the integrity of the ecosystem and thus enhancing ecosystem resilience. Where appropriate, strongly interacting keystone species that have roles in maintaining the ecosystem should be reintroduced or depleted populations reinforced to an ecologically effective level.



## Principle 2

Rewilding employs landscape-scale planning that considers core areas, connectivity, and co-existence. At the landscape scale, it is crucial that core areas provide a secure space that accommodates the full array of species that comprise a self-sustaining natural ecosystem. These areas may be either legally designated or under private management. Restoring connectivity between core areas promotes movement and migration across the wider landscape and improves resilience to the impacts of climate change. Rewilding can build on existing core areas, such as designated wilderness areas, national parks, or privately managed natural areas. Plans for rewilding at the landscape scale should accommodate the need for coexistence between wild species and humans (and livestock) through careful integration of cores and connectivity in functioning ecological networks and zoned systems of compatible low-intensity human land use (e.g., buffers and extensive multiple-use landscapes).

## Principle 3

Rewilding focuses on the recovery of ecological processes, interactions, and conditions based on reference ecosystems. Rewilding should aim to restore self-sustaining and resilient ecosystems and specifically the natural patterns and dynamics of abundance, distribution, and interactions between native species. To do this, rewilding should make use of an appropriate ecological reference. Any reference point is ultimately arbitrary, but it is expected to be self-sustaining and resilient. A reference can be based on carefully selected contemporary near-natural reference areas with relatively complete biota where these still exist or appropriate scientific or historical evidence supported by expert indigenous and local knowledge. Rewilding should allow for natural disturbance within an evolutionary relevant range of variability and take environmental change into account. Key native species that have become globally extinct can be replaced by suitable carefully selected wild surrogates, where legislation permits and their ecological role is deemed important. The surrogate should, where possible, be phylogenetically close to and have similar ecological and trophic functionality as the extinct species and appropriate management and monitoring should be put in place.

## Principle 4

Rewilding recognizes that ecosystems are dynamic and constantly changing. Temporal change, both allogenic (external) and autogenic (internal), is a fundamental attribute of ecosystems and the evolutionary processes critical to ecosystem function. Allogenic factors include storms, floods, wildfire, and large-scale changes in climate. Equally important are changes from autogenic processes, such as nutrient cycles, energy and genes flows, decomposition, herbivory, pollination, seed dispersal, and predation. Conservation planning for rewilding should consider the dynamic nature of ecosystems and be responsive to indi-

vidual species range shifts and the disaggregation and assembly of genes, species, and biotic communities. Rewilding should facilitate the space and connectivity needed for these processes to have free reign, allowing the wider processes of succession, disturbance, and biotic interactions to determine ecological trajectories without impediment or constraint. Rewilding programs must take both genetic and ecologically effective population sizes into account and employ strategies (e.g., connectivity) that ensure ecologically sustainable and genetically healthy populations of animals, plants, and other organisms. Where species of concern are globally rare and in danger of extinction, intervention may be required to prevent this from happening, including more traditional conservation measures, such as reserves and captive breeding.

## Principle 5

Rewilding should anticipate the effects of climate change and where possible act as a tool to mitigate impacts. Anthropogenic impacts of climate change are rapid and pervasive, creating the need to anticipate the likely impacts on rewilding. Rewilding projects have medium- to long-term time scales that inevitably span the predicted scales and magnitudes of global climate change as regards warming trends, ice sheet collapse, sea-level rise, storm events, and so forth; thus, climate change needs to be considered when planning such projects. Rewilding can also be considered an example of an NbS with the potential to absorb, ameliorate, and tackle the effects of climate change. This includes mitigating the impacts of climate change on ecosystems and increasing the capture of atmospheric carbon (e.g., through natural regeneration following land abandonment and replacing livestock with wild herbivores) as well as providing ample space and connectivity along environmental and climatic gradients to enhance opportunities for species movements.

## Principle 6

Rewilding requires local engagement and support. Rewilding should be inclusive of all stakeholders and embrace participatory approaches and transparent local consultation in the planning process for any project. Rewilding should encourage public understanding and appreciation of wild nature and should address existing concerns about coexisting with wildlife and natural processes of disturbance. Stakeholder engagement and support can reinforce the use of rewilding as an opportunity to promote education and knowledge exchange about the functioning of ecosystems. Although everyone is a potential stakeholder, no one strategy will satisfy everyone all the time and rewilding projects will need to address barriers to acceptance.

## Principle 7

Rewilding is informed by science, traditional ecological knowledge (TEK), and other local knowledge. Traditional ecological knowledge provides a complementary body of knowledge

to science and collaborations between researchers. Holders of TEK and other local experts can generate benefits that maximize innovation and best management guidance through knowledge exchange, transparency, and mutual learning. This can include, for example, the role of customary institutions that rely on cultural values, such as sharing and eco-reciprocity in relation to transmission of ecological knowledge. All these forms of knowledge are important for the success of rewilding projects and can help inform adaptive management frameworks and gather evidence. Local experts can provide detailed knowledge of sites, their histories, and processes, all of which can inform rewilding outcomes. It is important to acknowledge knowledge gaps and be aware of shifting baselines and the implications of these for rewilding projects while ensuring that traditional practices are sustainable and supported by appropriate evidence. Projects themselves can form the basis for knowledge generation, data, and information of use to future projects.

### Principle 8

Rewilding is adaptive and dependent on monitoring and feedback. Monitoring is essential to provide evidence of short- and medium-term results with long-term rewilding goals in mind. This is required to determine whether rewilding trajectories, such as a particular treatment, are working as planned. Participatory monitoring based on (SSG, using) simple crowd-sourced methods with local volunteers coupled with more detailed scientific monitoring can be used to provide the necessary data and information. Rewilding projects should use these data to identify problems and possible solutions as part of an appropriate adaptive management framework. These need to be adequately resourced such that further interventions can be implemented without loss to project budgets and resources.

### Principle 9

Rewilding recognizes the intrinsic value of all species and ecosystems. Although there is increasing recognition that natural ecosystems, and the species within them, provide valued goods and services to humans, wild nature has its own intrinsic value that humanity has an ethical responsibility to both respect and protect. This principle emphasizes the values of compassion and coexistence. Rewilding should primarily be an eco-centric, rather than an anthropocentric, activity. Where management interventions are required, these should focus on removal of human control and restoring native species with minimal intervention and nonlethal means wherever possible.

### Principle 10

Rewilding requires a paradigm shift in the coexistence of humans and nature. In alliance with the global conservation and restoration communities, rewilding means transformative change and provides optimism, purpose, and motivation for

engagement alongside a greater awareness of global ecosystems that are essential for life on the planet. This should lead to a paradigm shift in advocacy and activism for change in political will and help shift ecological baselines toward recovering fully functioning trophic ecosystems, such that society no longer accepts degraded ecosystems and overexploitation of nature as the baseline for each successive future generation. This paradigm shift will also help create new sustainable economic opportunities, delivering the best outcomes for nature and people.

## DISCUSSION

We recognize that these are high-level principles and that further work is required as the process of developing rewilding guidelines specific and applicable across a range of landscapes, ecosystems, and social contexts is developed. We also recognize that (with a few notable exceptions aside) rewilding has largely focused on terrestrial ecosystems, and better understanding and accountability are needed for rewilding processes in other contexts, including marine, freshwater, and underground ecosystems. This work needs to be done urgently. Time is running out because the more degraded natural ecosystems there are, the more difficult it becomes to rewild ecosystems that support the biospheric functions vital to all life on Earth. Rewilding challenges the cultural norms of narrow targets and controls across both conservation and society and instead gives autonomy to wild nature. The intrinsic nature of rewilding allows it to cross the scientific discursive boundary into the political, inviting individuals from all disciplines to approach it, discuss it, and to apply it (Bauer et al., 2009).

Rewilding takes a whole ecosystem recovery approach, incorporating elements of traditional protected area conservation, connectivity conservation, and community conservation. One of the principal aims of rewilding, to restore ecosystem structure and functions to achieve a self-sustaining autonomous nature, is closely aligned with ecological restoration and differences and similarities between the two approaches are a subject for further discussion and research (Anderson et al., 2019; Hayward et al., 2019). Rewilding recognizes the potential contribution of other related conservation approaches, such as the IUCN CEM NbS program (Cohen-Shacham et al., 2019). We suggest that differences in rewilding perspectives lie largely in the extent to which this is seen as achievable, to which restoration of ecosystem structure and function is aimed and pursued, and, ultimately, in those interventions that are necessary, feasible, or acceptable. An understanding of the contextual setting of rewilding projects is often the key to success, and careful site-specific interpretations will be most successful at achieving the aims of rewilding. As such, rewilding should be considered not only in terms of policy directives or the return of keystone species, but also as a response to larger questions of how wildness can persist and recover in a human-dominated world.

The guiding principles developed here by the IUCN CEM RTF in consultation with the global rewilding community state implicitly that rewilding exists sits on a continuum of scale,

connectivity, and level of human influence (Carver, 2014). Although the overall aim of rewilding is a self-sustaining ecosystem, the process itself can involve higher levels of human intervention at the beginning in order to set the environment on a path toward a wilder, more autonomous state (Carver, 2019; Torres et al., 2018; Van Meerbeek et al., 2019). We also recognize Bekoff's call for rewilding as compassionate conservation, where human intervention (e.g., to control non-native invasive animals) should be nonlethal wherever possible and use natural resistance and control (Bekoff, 2014; Guyton et al., 2020). An important point to note is that although rewilding may aim to redress human dominance in target ecosystems, the self-perpetuation of these relies on tolerance and the desire for a more meaningful coexistence between people and nature, such as those espoused by many Indigenous peoples. For any rewilding strategy to succeed, society and nature need to be fully integrated. The solution may lie with how rewilding straddles the land-sharing versus land-sparing concept, how it cuts through these two contrasting views of nature conservation (Navarro & Pereira, 2015), and how it engages with the nature-needs-half (Locke, 2014) and half-earth visions (Wilson, 2016).

Above all, rewilding is an empowering narrative; its natural and social science and spatiotemporal approach offers much to encourage a greater ecocentric view of the world (Taylor et al., 2020). For this reason, it has gained much support—while simultaneously attracting criticism and controversy—across a wide range of disciplines and stakeholders. Nonetheless, for rewilding to truly gain acceptance and traction in mainstream conservation policy and practice it needs to be fully and properly defined within a workable and widely accepted set of guiding principles. The definition and principles outlined here contribute to this goal and provide a reference point for rewilding and its incorporation into global conservation targets, including those of the IUCN, the UN Decade on Ecosystem Restoration, and post-2020 Global Biodiversity Framework.

## ACKNOWLEDGMENTS

We acknowledge the support of the IUCN CEM and those rewilding pioneers and experts who responded to the survey, took part in workshops, or both. We also acknowledge the helpful comments of the reviewers and journal editors. We dedicate this paper to the memory of Michael Soulé and Alison Parfitt. In their own ways they both contributed greatly to conservation science and the preparation of this article. We cherish their friendship and mourn their passing.


## ORCID

Steve Carver  <https://orcid.org/0000-0002-4202-8234>

Ian Convery  <https://orcid.org/0000-0003-2527-5660>

Yue Cao  <https://orcid.org/0000-0001-5379-1289>

Reed Noss  <https://orcid.org/0000-0003-2997-4688>

Meredith Root-Bernstein  <https://orcid.org/0000-0002-2513-1248>

Laetitia M. Navarro  <https://orcid.org/0000-0003-1099-5147>

## REFERENCES

- Anderson, R. M., Buitenwerf, R., Driessen, C., Genes, L., Lorimer, J., & Svenning, J. C. (2019). Introducing rewilding to restoration to expand the conservation effort: A response to Hayward et al. *Biodiversity and Conservation*, 28(13), 3691–3693.
- Bauer, N., Wallner, A., & Hunziker, M. (2009). The change of European landscapes: Human-nature relationships, public attitudes towards rewilding, and the implications for landscape management in Switzerland. *Journal of Environmental Management*, 90(9), 2910–2920.
- Bekoff, M. (2014). *Rewilding our hearts: Building pathways of compassion and coexistence*. New World Library.
- Bocking, S. (2015). Ecological concepts: Seeing, placing, imposing. *Geoforum*, 65, 489–492.
- Brown, C., McMorran, R., & Price, M. F. (2011). Rewilding—A new paradigm for nature conservation in Scotland? *Scottish Geographical Journal*, 127(4), 288–314.
- Butler, J. R., Young, J. C., & Marzano, M. (2019). Adaptive co-management and conflict resolution for rewilding across development contexts. In N. Pettorelli, S. Durant, & J. du Toit (Eds.), *Rewilding* (pp. 386–412). Cambridge University Press.
- Carey, J. (2016). Core concept: Rewilding. *Proceedings of the National Academy of Sciences*, 113, 806–808.
- Carroll, C., & Noss, R. F. (2020). Rewilding in the face of climate change. *Conservation Biology*, 35(1), 155–167.
- Carver, S. (2013). (Re)creating wilderness: Rewilding and habitat restoration. In E. Waterton, I. Thompson, & P. Howard (Eds.), *The Routledge companion to landscape studies* (pp. 401–412). Routledge.
- Carver, S. (2014). Making real space for nature: A continuum approach to UK conservation. *ECOS*, 35(3–4), 4–14.
- Carver, S. (2016). Rewilding... conservation and conflict. *ECOS*, 37(2), 2–10.
- Carver, S. (2019). Rewilding through land abandonment. In N. Pettorelli, S. Durant, & J. du Toit (Eds.), *Rewilding* (pp. 99–122). Cambridge University Press.
- Ceballos, G., Ehrlich, P. R., Barnosky, A. D., García, A., Pringle, R. M., & Palmer, T. M. (2015). Accelerated modern human-induced species losses: Entering the sixth mass extinction. *Science Advances*, 1(5), e1400253.
- Cerqueira, Y., Navarro, L. M., Maes, J., Marta-Pedroso, C., Honrado, J. P., & Pereira, H. M. Ecosystem services: The opportunities of rewilding in Europe. In H. M. Pereira & L. M. Navarro (Eds.), *Rewilding European landscapes* (pp. 47–64). Springer.
- Cloyd, A. A. (2016). Reimagining rewilding: A response to Jørgensen, Prior, and Ward. *Geoforum*, 76, 59–62.
- Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., Maginnis, S., Maynard, S., Nelson, C. R., Renaud, F. G., Welling, R., & Walters, G. (2019). Core principles for successfully implementing and upscaling nature-based solutions. *Environmental Science & Policy*, 98, 20–29.
- Corlett, R. T. (2016). Restoration, reintroduction, and rewilding in a changing world. *Trends in Ecology & Evolution*, 31(6), 453–462.
- Deary, H., & Warren, C. R. (2017). Divergent visions of wildness and naturalness in a storied landscape: Practices and discourses of rewilding in Scotland's wild places. *Journal of Rural Studies*, 54, 211–222.
- Derham, T. T. (2019). In defence of 'rewilding'—A response to Hayward et al. (2019). *Biological Conservation*, 236, 583.
- Donlan, J., Berger, J., Bock, C. E., Bock, J. H., Burney, D. A., Estes, J. A., Foreman, D., Martin, P. S., Roemer, G. W., Smith, F. A., Soulé, M. E., & Greene, H. W. (2006). Pleistocene rewilding: An optimistic agenda for twenty-first century conservation. *The American Naturalist*, 168(5), 660–681.
- Drenthen, M. (2015). The return of the wild in the Anthropocene. Wolf resurgence in the Netherlands. *Ethics, Policy & Environment*, 18(3), 318–337.
- Fisher, M., & Parfitt, A. (2016). The challenge of wild nature conserving itself. *ECOS*, 37(3/4), 27–34.
- Foreman, D. (1998). The wildlands project and the rewilding of North America. *Denver University Law Review*, 76(2), 535–553.
- Foreman, D. (2014). The myth of the humanized pre-Columbian landscape. In G. Wuerthner, E. Crist, & T. Butler (Eds.), *Keeping the wild* (pp. 114–125). Island Press.



- Fraser, L. H., Harrower, W. L., Garriss, H. W., Davidson, S., Hebert, P. D., Howie, R., Moody, A., Polster, D., Schmitz, O. J., Sinclair, A. R. E., Starzomski, B. M., Sullivan, T. P., & Turkington, R. (2015). A call for applying trophic structure in ecological restoration. *Restoration Ecology*, 23(5), 503–507.
- Galetti, M., Root-Bernstein, M., & Svenning, J. C. (2017). Challenges and opportunities for rewilding South American landscapes. *Perspectives in Ecology and Conservation*, 15, 245–247.
- Gammon, A. R. (2018). The many meanings of rewilding: An introduction and the case for a broad conceptualisation. *Environmental Values*, 27(4), 331–350.
- Gann, G. D., McDonald, T., Walder, B., Aronson, J., Nelson, C. R., Jonson, J., Hallett, J. G., Eisenberg, C., Guariguata, M. R., Liu, J., Hua, F., Echeverría, C., Gonzales, E., Shaw, N., Decler, K., & Dixon, K. W. (2019). International principles and standards for the practice of ecological restoration. Second edition. *Restoration Ecology*, 27(S1), S1–S46.
- Guyton, J. A., Pansu, J., Hutchinson, M. C., Kartzinell, T. R., Potter, A. B., Coverdale, T. C., Daskin, J. H., da Conceição, A. G., Peel, M. J. S., Stalmans, M. E., & Pringle, R. M. (2020). Trophic rewilding revives biotic resistance to shrub invasion. *Nature Ecology & Evolution*, 4(5), 712–724.
- Hansen, D. M. (2010). On the use of taxon substitutes in rewilding projects on islands. In V. Pérez-Mellado & C. Ramon (Eds.), *Islands and evolution* (pp. 111–146). Institut Menorquí d'Estudis.
- Hayward, M. W., Scanlon, R. J., Callen, A., Howell, L. G., Klop-Toker, K. L., Di Blanco, Y., Balkenhol, N., Bugir, C. K., Campbell, L., Caravaggi, A., Chalmers, A. C., Clulow, J., Clulow, S., Cross, P., Gould, J. A., Griffin, A. S., Heurich, M., Howe, B. K., Jachowski, D. S., ... Weise, F. J. (2019). Reintroducing rewilding to restoration—Rejecting the search for novelty. *Biological Conservation*, 233, 255–259.
- Hodder, K., & Bullock, J. (2020). Nature Without Nurture? *Restoration and History* 241–253.
- Johns, D. (2019). History of rewilding: Ideas and practice. In N. Pettoirelli, S. Durant, & J. du Toit (Eds.), *Rewilding* (pp. 12–33). Cambridge University Press.
- Johnson, C. N., Balmford, A., Brook, B. W., Buettel, J. C., Galetti, M., Guangchun, L., & Wilmschurst, J. M. (2017). Biodiversity losses and conservation responses in the Anthropocene. *Science*, 356(6335), 270–275.
- Jørgensen, D. (2015). Rethinking rewilding. *Geoforum*, 65, 482–488.
- Kaiser-Bunbury, C. N., Traveset, A., & Hansen, D. M. (2010). Conservation and restoration of plant–animal mutualisms on oceanic islands. *Perspectives in Plant Ecology, Evolution and Systematics*, 12(2), 131–143.
- Kopnina, H., Leadbeater, S., & Cryer, P. (2019). Learning to rewild: Examining the failed case of the Dutch “New Wilderness” Oostvaardersplassen. *International Journal of Wilderness*, 25(3), 72–89.
- Lake, P. S. (2012). Resistance, resilience and restoration. *Ecological Management & Restoration*, 14(1), 20–24.
- Lesslie, R. G., & Taylor, S. G. (1985). The wilderness continuum concept and its implications for Australian wilderness preservation policy. *Biological Conservation*, 32(4), 309–333.
- Locke, H. (2014). Nature needs half: A necessary and hopeful new agenda for protected areas. *Nature New South Wales*, 58(3), 7–17.
- Merckx, T., & Pereira, H. M. (2015). Reshaping agri-environmental subsidies: From marginal farming to large-scale rewilding. *Basic and Applied Ecology*, 16(2), 95–103.
- Moss, B. (2015). Mammals, freshwater reference states, and the mitigation of climate change. *Freshwater Biology*, 60(9), 1964–1976.
- Murray, M. (2017). Wild pathways of inclusive conservation. *Biological Conservation*, 214, 206–212.
- Navarro, L. M., & Pereira, H. M. (2015). Rewilding abandoned landscapes. In H. M. Pereira & L. M. Navarro (Eds.), *Rewilding European landscapes* (pp. 3–23). Springer.
- Noss, R. F. (1985). Wilderness recovery and ecological restoration: An example for Florida. *Earth First!*, 5(8), 18–19.
- Noss, R. F. (2020). The spectrum of wildness and rewilding: Justice for all. In H. Kopnina & H. Washington (Eds.), *Conservation: Integrating social and ecological justice* (pp. 167–182). Springer.
- Paine, R. T. (1980). Food webs: Linkage, interaction strength and community infrastructure. *Journal of Animal Ecology*, 49(3), 667–685.
- Payne, J. L., Bush, A. M., Heim, N. A., Knope, M. L., & McCauley, D. J. (2016). Ecological selectivity of the emerging mass extinction in the oceans. *Science*, 353(6305), 1284–1286.
- Pedersen, P. B. M., Ejrnæs, R., Sandel, B., & Svenning, J. C. (2020). Trophic Rewilding Advancement in Anthropogenically Impacted Landscapes (TRAIL): A framework to link conventional conservation management and rewilding. *Ambio*, 49(1), 231–244.
- Pettorelli, N., Barlow, J., Stephens, P. A., Durant, S. M., Connor, B., Böhne, H., ... du Toit, J. T. (2018). Making rewilding fit for policy. *Journal of Applied Ecology*, 55, (3):1114–1125.
- Perino, A., Pereira, H. M., Navarro, L. M., Fernández, N., Bullock, J. M., Ceaşu, S., Cortés-Avizanda, A., van Klink, R., Kuemmerle, T., Lomba, A., Pe'er, G., Plieninger, T., Rey Benayas, J. M., Sandom, C. J., Svenning, J.-C., & Wheeler, H. C. (2019). Rewilding complex ecosystems. *Science*, 364(6438), eaav5570.
- Pires, M. M. (2017). Rewilding ecological communities and rewiring ecological networks. *Perspectives in Ecology and Conservation*, 15, 257–265.
- Power, M. E., Tilman, D., Estes, J. A., Menge, B. A., Bond, W. J., Mills, L. S., Daily, G., Castilla, J. C., Lubchenco, J., & Paine, R. T. (1996). Challenges in the quest for keystones: Identifying keystone species is difficult—but essential to understanding how loss of species will affect ecosystems. *Bioscience*, 46(8), 609–620.
- Preston, C. J. (2015). The multiple Anthropocenes: Toward fracturing a totalizing discourse. *Environmental Ethics*, 37(3), 307–320.
- Prior, J., & Ward, K. J. (2016). Rethinking rewilding: A response to Jørgensen. *Geoforum*, 69, 132–135.
- Pringle, R. (2017). Upgrading protected areas to conserve wild biodiversity. *Nature*, 546(7656), 91–99.
- Repanshek, K. (2019). *Re-bisoning the west: Restoring an American icon to the landscape*. Torrey House Press.
- Ripple, W., Wolf, C., Newsome, T. M., Galetti, M., Alamgir, M., Crist, E., Mahmoud, M. I., Laurance, W. F., & 15,364 scientist signatories from 184 countries. (2017). World scientists' warning to humanity: A second notice. *Bioscience*, 67(12), 1026–1028.
- Ripple, W. J., Estes, J. A., Beschta, R. L., Wilmers, C. C., Ritchie, E. G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M. P., Schmitz, O. J., Smith, D. W., Wallach, A. D., & Wirsing, A. J. (2014). Status and ecological effects of the world's largest carnivores. *Science*, 343(6167), 1241484.
- Robbins, P., & Moore, S. (2013). Ecological anxiety disorder: Diagnosing the politics of the Anthropocene. *Cultural Geographies*, 20(1), 3–19.
- Root-Bernstein, M., Gooden, J., & Boyes, A. (2018). Rewilding in practice and in policy. *Geoforum*, 97, 292–304.
- Smith, R. D., & Maltby, E. (2001). *Using the ecosystem approach to implement the CBD*. A global synthesis report drawing lessons from three regional pathfinder workshops. Royal Holloway Institute for Environmental Research, Royal Holloway, University of London.
- Soulé, M. E. (1999). An unflinching vision: Networks of people for networks of wildlands. *Wild Earth*, 9(4), 38–46.
- Soulé, M. E., & Noss, R. (1998). Rewilding and biodiversity: Complementary goals for continental conservation. *Wild Earth*, 8(3), 18–28.
- Svenning, J. C., & Faurby, S. (2017). Prehistoric and historic baselines for trophic rewilding in the Neotropics. *Perspectives in Ecology and Conservation*, 15(4), 282–291.
- Tanasescu, M. (2017). Field notes on the meaning of rewilding. *Ethics, Policy & Environment*, 20(3), 333–349.
- Taylor, B., Chapron, G., Kopnina, H., Orlikowska, E., Gray, J., & Piccolo, J. (2020). The need for ecocentrism in biodiversity conservation. *Conservation Biology*, 34(5), 1089–1096.
- Torres, A., Fernández, N., Zu Ermgassen, S., Helmer, W., Revilla, E., Saavedra, D., Perino, A., Mimet, A., Rey-Benayas, J. M., Selva, N., Sheepers, F., Svenning, J.-C., & Pereira, H. M. (2018). Measuring rewilding progress. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1761), 20170433.
- Van Maanen, E., & Convery, I. (2016). Rewilding: The realisation and reality of a new challenge for nature in the twenty-first century. In I. Convery, P. Davis, & M. Holdgate (Eds.), *Changing perceptions of nature* (pp. 303–319). University of Newcastle upon Tyne.

- Van Meerbeek, K., Muys, B., Schowanek, S. D., & Svenning, J. C. (2019). Reconciling conflicting paradigms of biodiversity conservation: Human intervention and rewilding. *Bioscience*, 69(12), 997–1007.
- Vera, F. W. M. (2000). *Grazing ecology and forest history*. CABI Publishing.
- Ward, K. (2019). For wilderness or wildness? Decolonising rewilding. In N. Petorelli, S. Durant, & J. du Toit (Eds.), *Rewilding* (pp. 34–54). Cambridge University Press.
- Watson Featherstone, A. (1997). The wild heart of the highlands. *ECOS*, 18, 48–61.
- Wilderness Foundation Global. (2020). *Global Charter for Rewilding Earth: Advancing nature-based solutions to the extinction and climate crises*. WILD Foundation.
- Wilson, E. O. (2016). *Half-earth: Our planet's fight for life*. WW Norton & Company.
- Wynne-Jones, S., Strouts, G., O'Neil, C., & Sandom, C. (2019). Rewilding—Departures in conservation policy and practice? An evaluation of developments in Britain. *Conservation and Society*, 18(2), 89–102.

- Zamboni, T., Di Martino, S., & Jiménez-Pérez, I. (2017). A review of a multispecies reintroduction to restore a large ecosystem: The Iberá Rewilding Program (Argentina). *Perspectives in Ecology and Conservation*, 15(4), 248–256.

## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**How to cite this article:** Carver S, et al. (2021) Guiding principles for rewilding. *Conservation Biology*, 1–12. <https://doi.org/10.1002/cobi.13730>